These homework problems are suggested and will not be turned in for review. However, answers will be available for them the following week by your class TAs. For more homework feel free to go to the Homework page.

Q1

Give the systematic names of [Co(NH₃)₄Cl₂]Br, K₃Cr(CN)₅, and Na₂CoCl₄.

Q2

Write the formulas for each of the following compounds by using brackets to distinguish the complex ion from the other ions:

a. hexaaquonickel(II) perchlorate
b. trichlorotriammineplatinum(IV) bromide
c. dichlorotetraammineplatinum(IV) sulfate
d. potassium monochloropentacyanoferrate (III)

Q3

Write the formula for each of the following by using brackets to distinguish the complex ion:

a. hydroxopentaaquoaluminum(III) chloride
b. sodium tricarbonatocobaltate(III)
c. sodium hexacyanoferrate(II)
d. ammonium hexanitrocobaltate(III)

Q4

When silver nitrate is added to a solution of a substance with the empirical formula CoCl₃ · 5NH₃, how many moles of AgCl will be precipitated per mole of cobalt present? Why?

Q5

Co(III) occurs in octahedral complexes with the general empirical formula CoCl₃ · nNH₃. What values of n and m are possible? What are the values of n and m for the complex that precipitates 1 mole of AgCl for every mole of Co present?
Q6
How many ions per mole will you expect to find in solution when a compound with the empirical formula PtCl\textsuperscript{4−} \cdot 3NH\textsubscript{3} is dissolved in water? What about PtCl\textsubscript{2} \cdot 3NH\textsubscript{3}? Draw diagrams of each of the complex cations.

Q7
Each of the following is dissolved in water to make a 0.001 M solution. Rank the compounds in order of decreasing conductivity of their solutions; K\textsubscript{2}PtCl\textsubscript{6}, Co(NH\textsubscript{3})\textsubscript{6}Cl\textsubscript{3}, Cr(NH\textsubscript{3})\textsubscript{4}Cl\textsubscript{3}, Pt(NH\textsubscript{3})\textsubscript{6}Cl\textsubscript{4}. Rewrite each compound by using brackets to distinguish the complex ion present in aqueous solution.

Q8
How many isomers are there of the compound [Cr(NH\textsubscript{3})\textsubscript{4}Cl\textsubscript{2}]Cl? Sketch them.

Q9
Sketch all the geometrical and optical isomers of PtCl\textsubscript{2}l\textsubscript{2}(NH\textsubscript{3})\textsubscript{2}.

Q10
How many geometrical and optical isomers are there of the complex ion Co(en)\textsubscript{2}Cl? Of these, how many pairs of isomers are there differing only by a mirror reflection? How many isomers have a plane of symmetry and hence do not exist in pairs of optical isomers?

Q11
Repeat Problem 10 with propylenediamine substituted for ethylenediamine. Ignore optical isomers from the propylene carbon.

Q12
How many different structural isomers are there of a substance with the empirical formula FeBrCl \cdot 3NH\textsubscript{3} \cdot 2H\textsubscript{2}O? For each different structural isomer, how many different geometrical isomers exist? How many of these can be grouped into right-handed and left-handed pairs of optical isomers?

Multiple Choice

1. What is the definition of a transition metal?
   - An element that has its s orbitals partially filled
   - An element that has its p orbitals partially filled
   - An element that has its d orbitals partially filled
An element that has its f orbitals partially filled

2. Which of the following statements about transition metals is true?
   - Typical transition metals have boiling points greater than 1000°C
   - Typical transition metals have melting points greater than 1000°C
   - Typical transition metals have melting points less than 1000°C
   - Transition metals are less dense than Group I metals

3. What is the electronic configuration of Cr?
   - \([\text{Ar}]\ 3d^3\ 4s^2\)
   - \([\text{Ar}]\ 3d^5\ 4s^2\)
   - \([\text{Ar}]\ 3d^4\ 4s^2\)
   - \([\text{Ar}]\ 3d^5\ 4s^1\)

4. Why is Mn\(^{2+}\) not readily oxidized to Mn\(^{3+}\)?
   - This is because the electronic configuration of Mn\(^{2+}\) is more stable than that of Mn\(^{3}\)
   - This is because the electronic configuration of Mn\(^{2+}\) is less stable than that of Mn\(^{3}\)
   - This is because Mn\(^{2+}\) does not have any more electrons in its d orbitals
   - This is because the Mn\(^{2+}\) cannot accept any more electrons in to its d orbital

5. In which order are the third and fourth level s, p and electrons filled in?
   - 3s, 3p, 3d, 4s
   - 3s, 3p, 4s, 3d
   - 3s, 4s, 3p, 3d
   - 4s, 3s, 3p, 3d

6. Which transition metal shows the greatest variation in possible oxidation numbers?
   - V
   - Cr
   - Mn
   - Fe

7. Why is Fe\(^{3+}\) more stable than Fe\(^{2+}\)?
   - The Fe\(^{3+}\) ion has a more stable 3d\(^5\) 4s\(^1\) electronic configuration
   - The Fe\(^{2+}\) ion has a more stable 3d\(^5\) 4s\(^1\) electronic configuration
   - The Fe\(^{3+}\) ion has a more stable 3d\(^5\) 4s\(^2\) electronic configuration
   - The Fe\(^{3+}\) ion has a more stable 3d\(^4\) 4s\(^2\) electronic configuration

8. Some transition metals exhibit paramagnetism. What does this mean?
• The metal is attracted to a magnet
• The metal is repelled by a magnet
• The metal acts like the north pole of a magnet
• The metal acts like the south pole of a magnet

9. What is meant by the term 'ligand'?
• A substance that can donate a lone pair of electrons to form a dative bond
• A substance that can accept a lone pair of electrons to form a dative bond
• A substance that can accept a lone pair of electrons to form hydrogen bond
• A substance that can donate a lone pair of electrons to form a hydrogen bond

11. Write the electron configurations of the following d-block elements.
   1. Vanadium
   2. Manganese
   3. Copper
   4. Zirconium

12. Transition element and d-block are 2 terms that are easily confused.
   1. Using the appropriate definitions, explain why Zn and Sc are not Transition metals.
   2. What would the oxidation states of the ions of Sc and Zn be?

13. What are the oxidation states of the transition metal in each of the following compounds?
   1. KMnO₄
   2. Na₂CrO₄
   3. CrO₃
   4. MnO₂
   5. Na₂Fe₂O₄
   6. Mn₂(CO)₁₀

14. Write the electronic configuration of the following atoms or ions.
   1. Fe
   2. Mn²⁺
   3. V³⁺
   4. Cu
   5. Cu⁺
   6. Cu²⁺

15. Describe the bonding in Co(en)₃³⁺ in terms of the simplest possible model.

16. List all the isomers of Cr(en)₂I₂⁺ and VO(H₂O)₂I₂. You can ignore the structure that is internal to the ligands.